Attenuation Length Spectrum and PE Yield

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BNL Daya Bay Meeting
June 5, 2009

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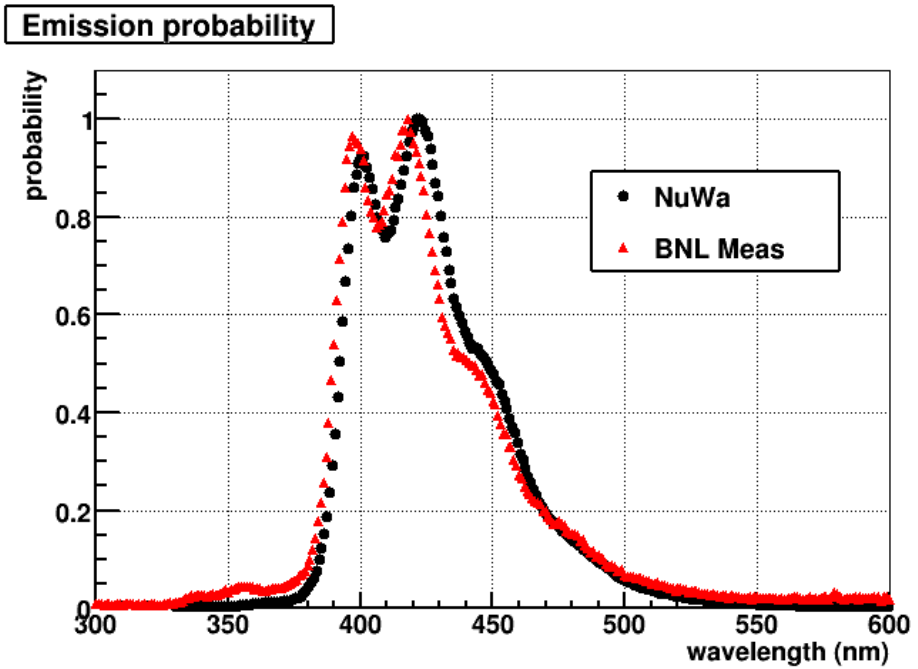
Outline for LS Workshop Talk

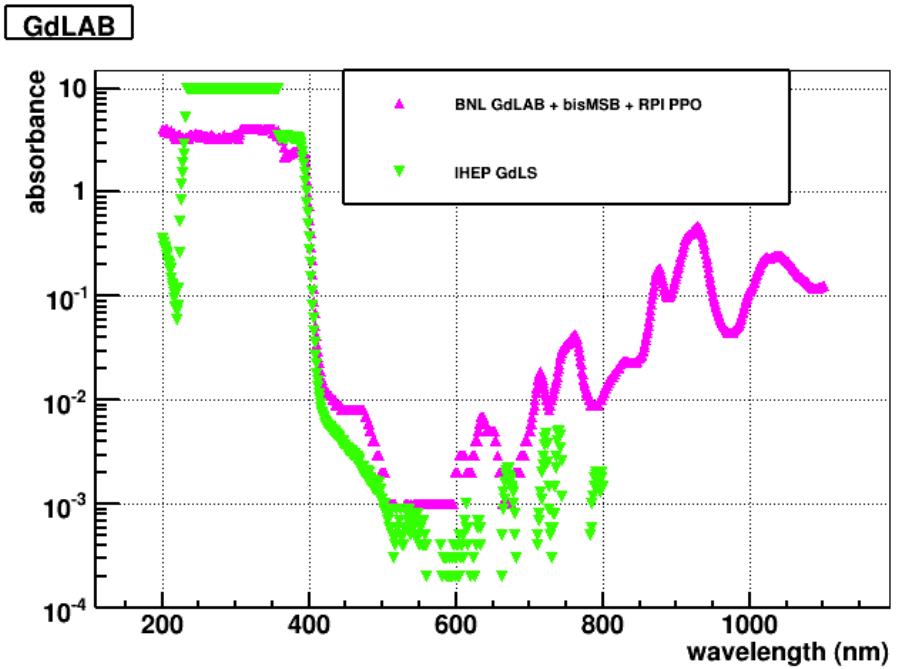
General goals: to understand how the shape of the attenuation length spectrum affects the pe yield and to use simulations to determine the spec for attenuation length of the LS

Background:
- briefly explain the optical model in the simulation
- show the absorption and emission spectrum currently in the simulation and where they came from

Explain my study

Measured emission and absorbance





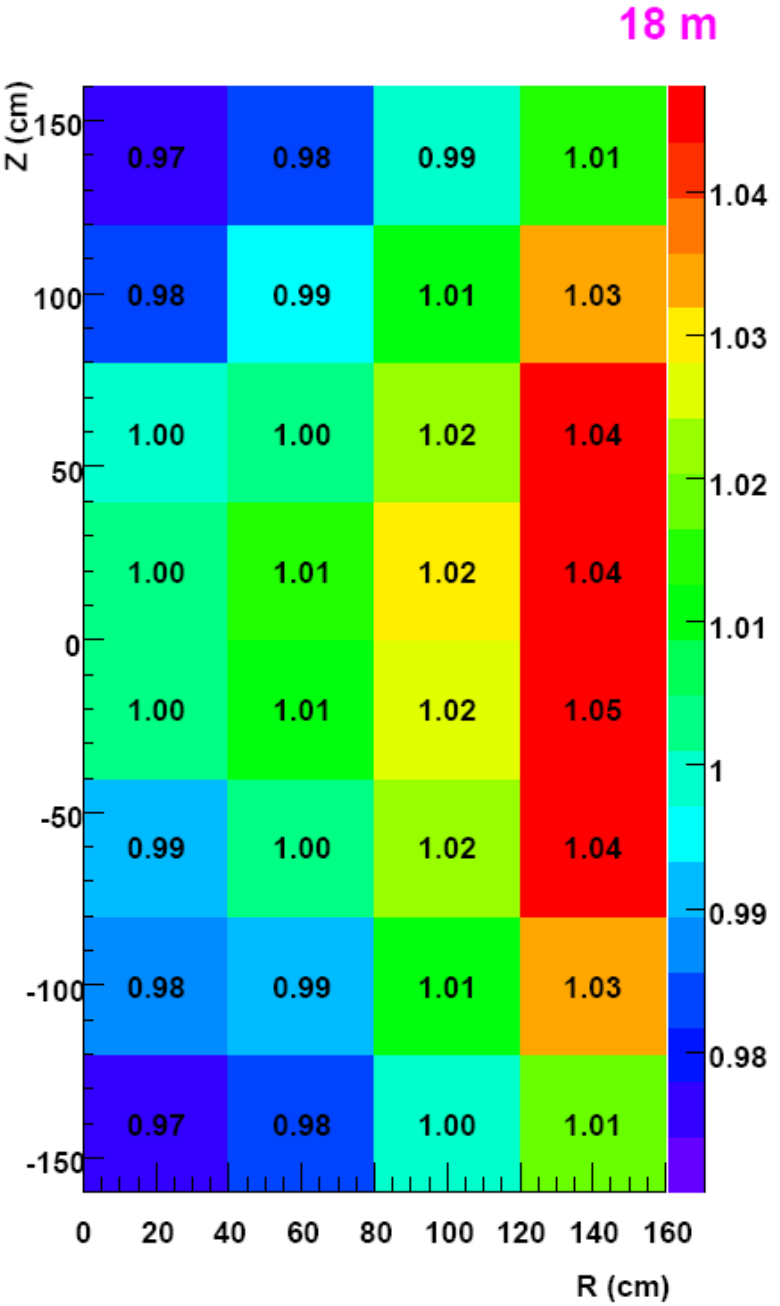
Requirements

simulation assumes 9000 photons/MeV (according to measurement in prototype)

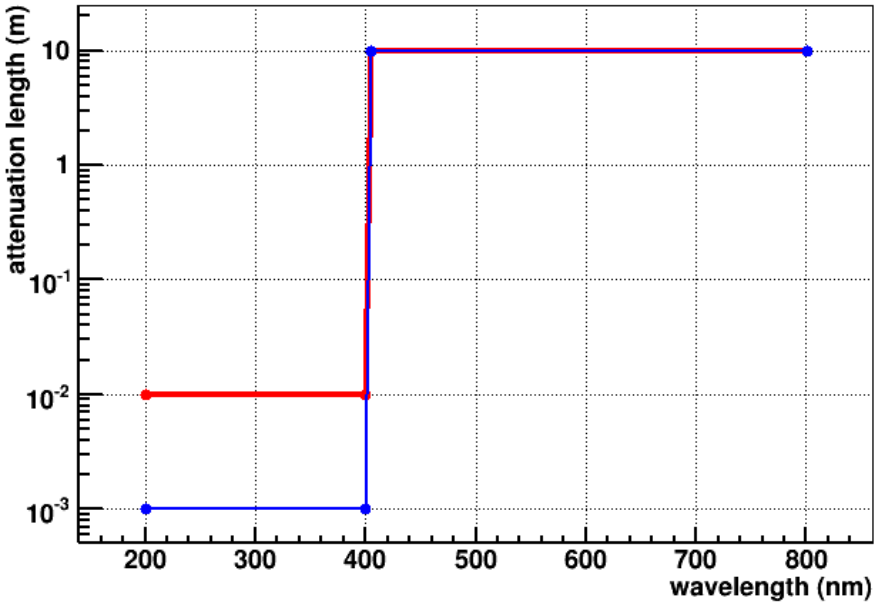
in current simulation, pe yield is ~135 pe/MeV

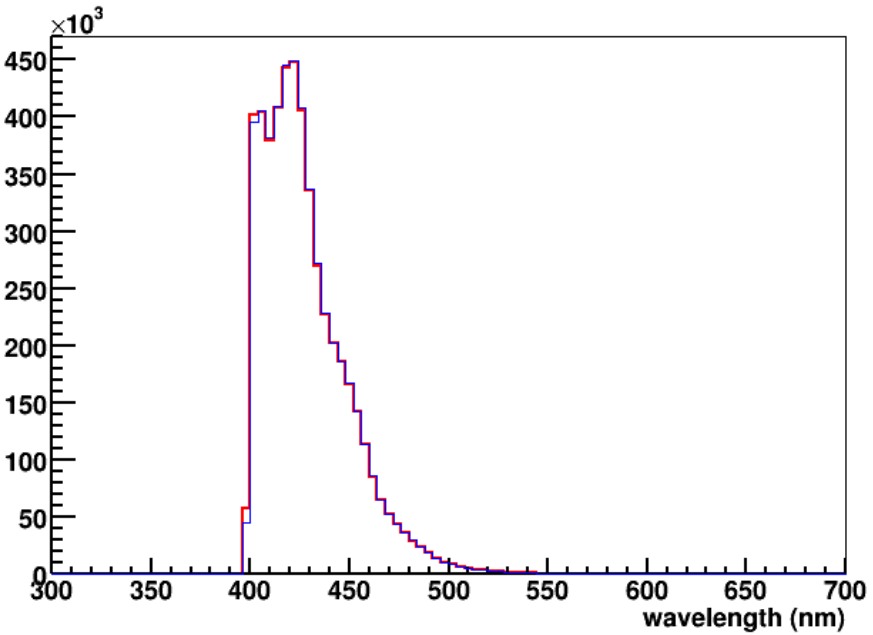
according to TDR:
>=100 detected pe/MeV is necessary for the energy-resolution requirement
>=10 m attenuation length (but at what wavelength?)

Gd capture pe yield uniformity:
from Jianglai's study, 5% non-uniformity between target center and edge is acceptable



<400 nm





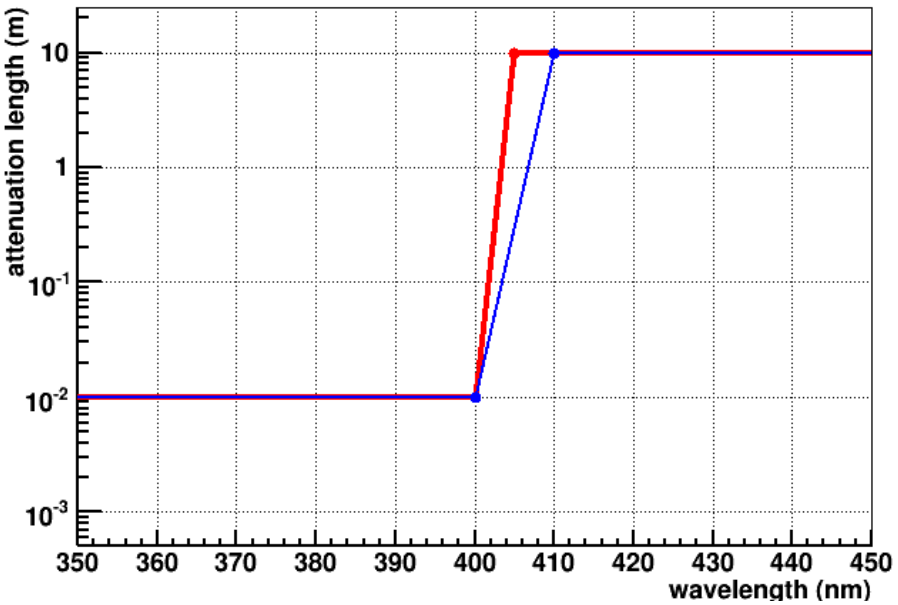
152 pe/MeV
153 pe/MeV

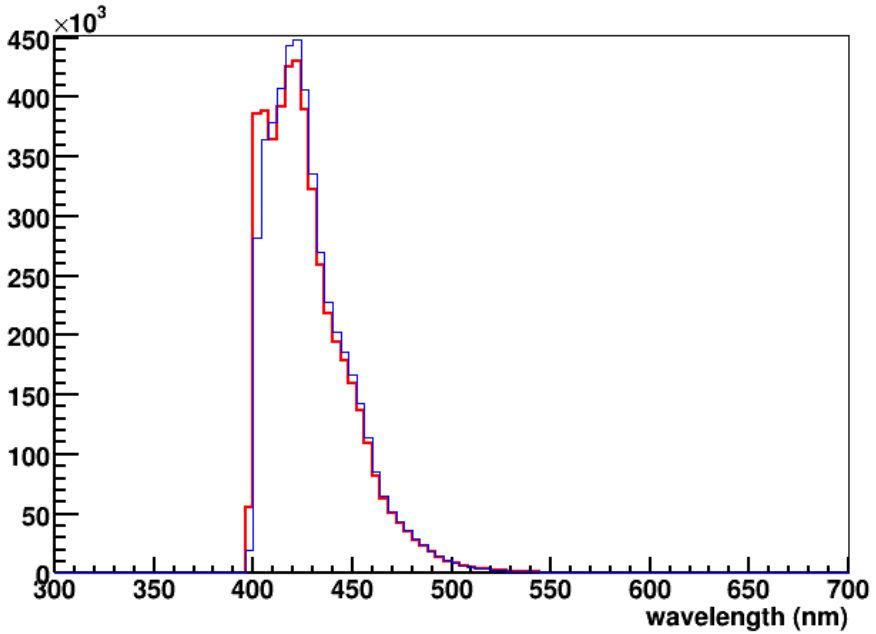
no difference between 1 mm and 1 cm

current value in simulation is 4 mm

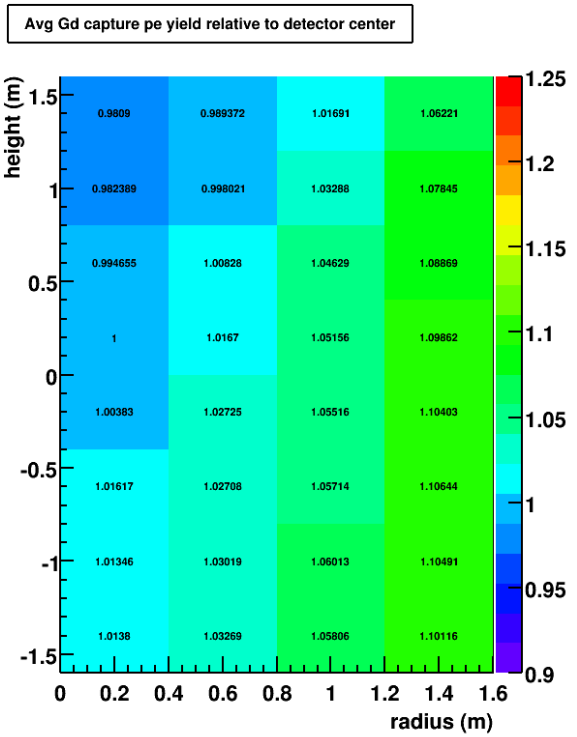
what is realistic? could it be a few cm? tens of cm?

The Edge

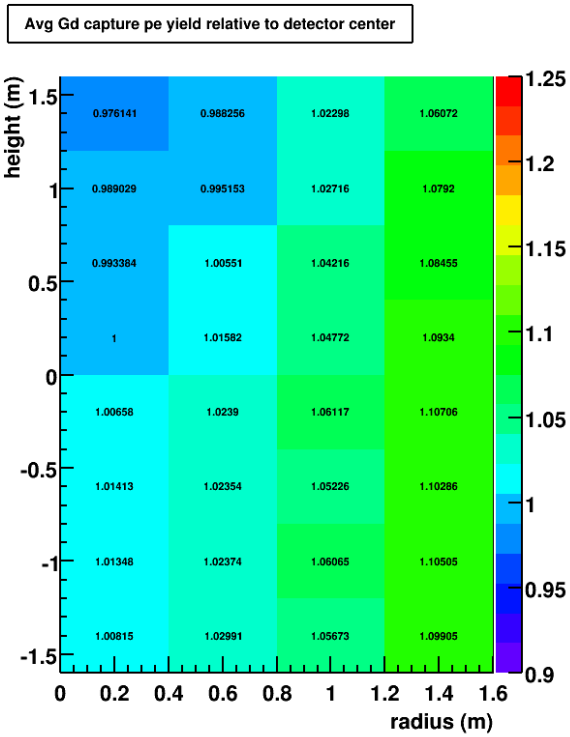




152 pe/MeV

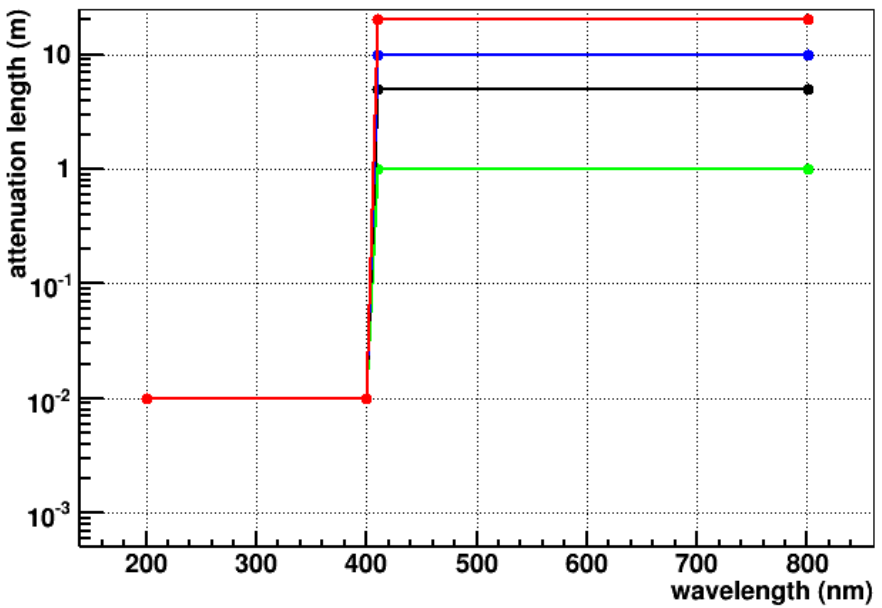


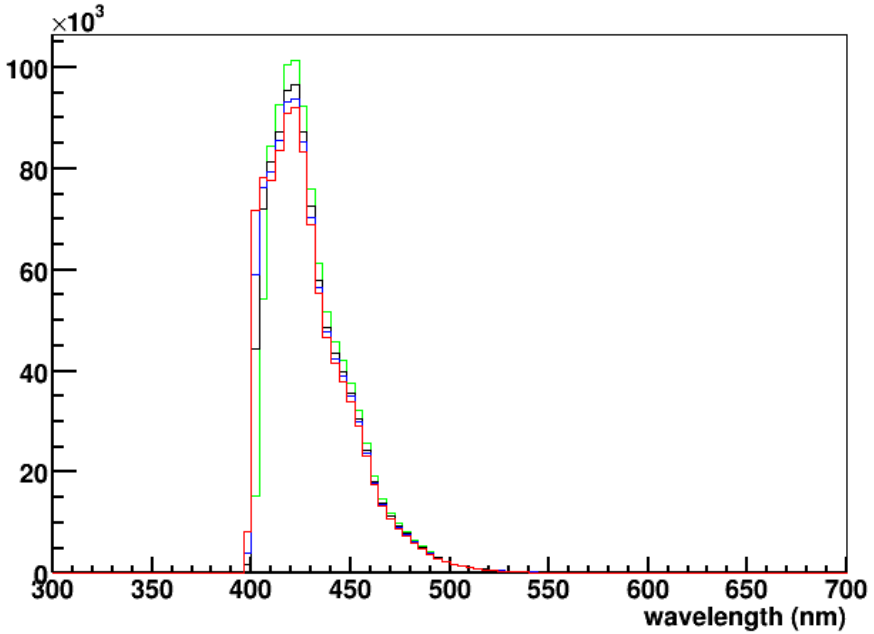
149 pe/MeV



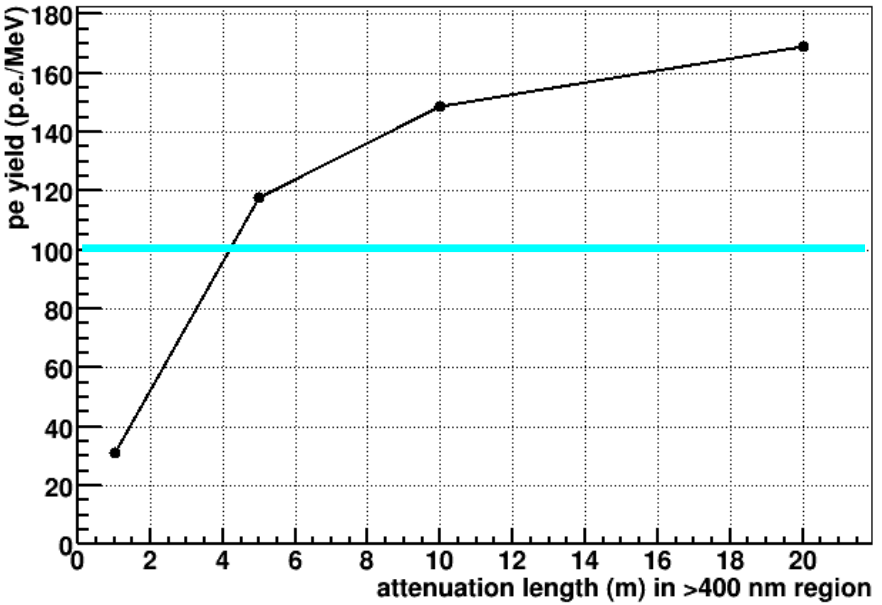
slope of the edge affects which photons we get, but not the overall pe yield or uniformity

>400 nm



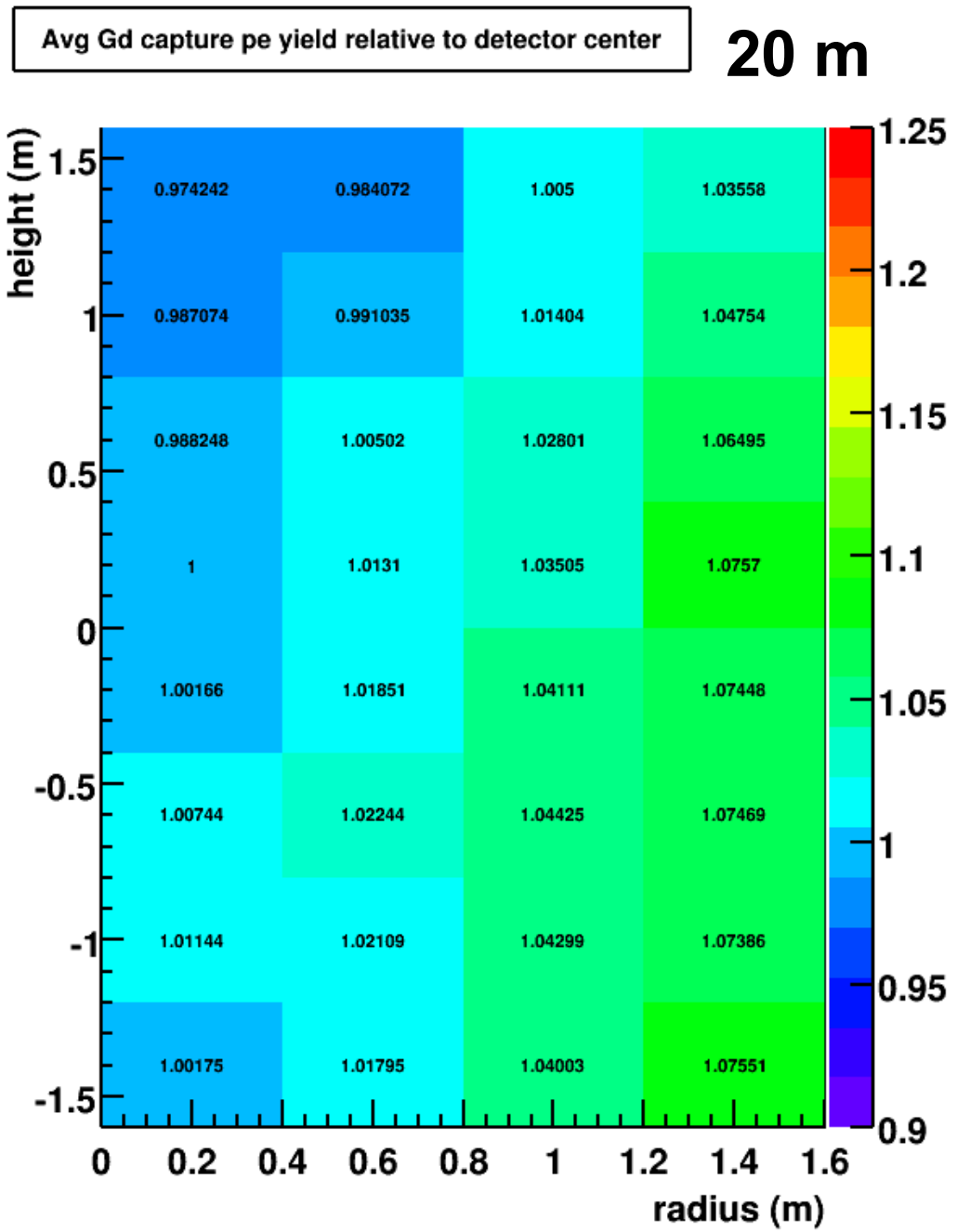


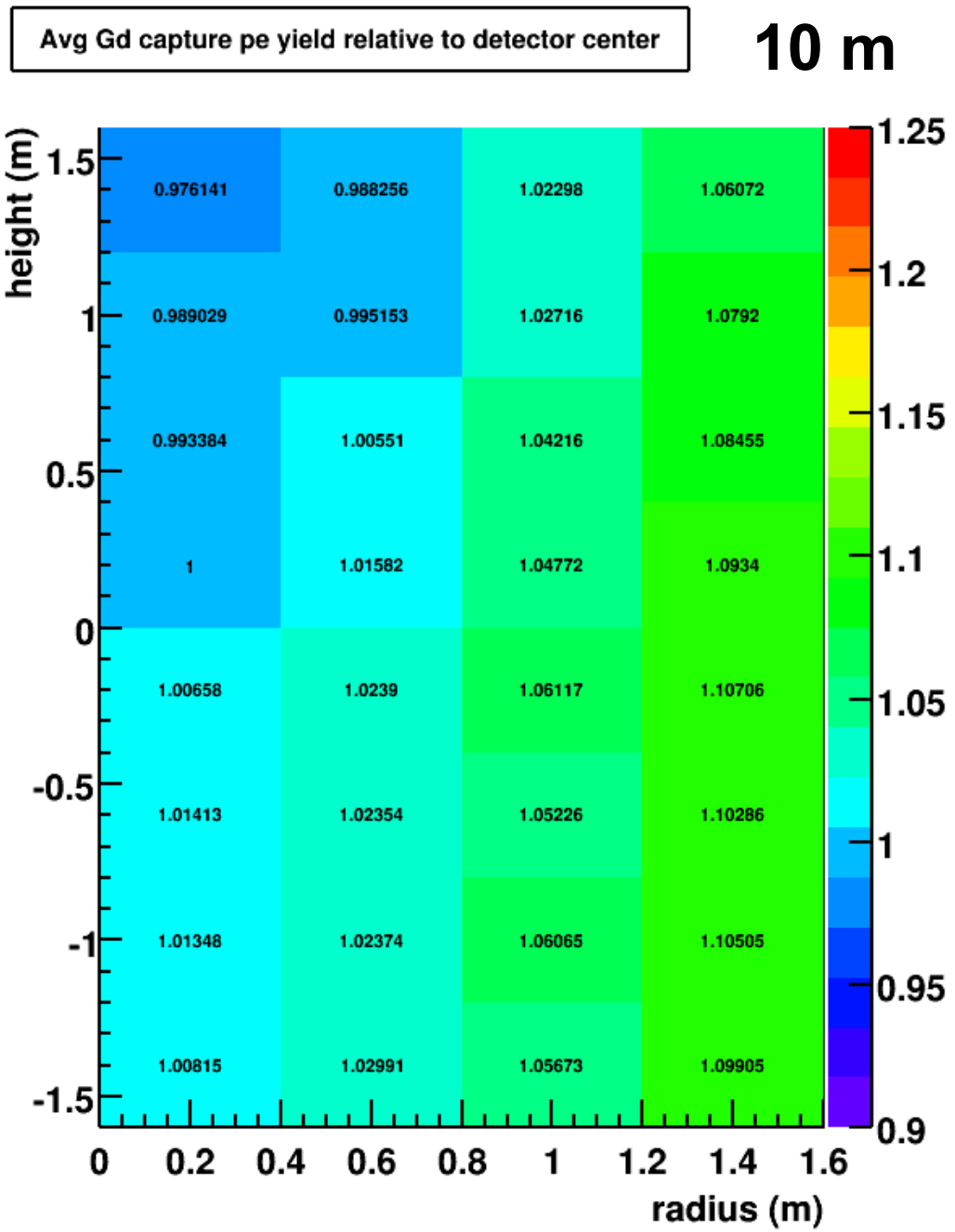
169 pe/MeV
149 pe/MeV
118 pe/MeV
31 pe/MeV



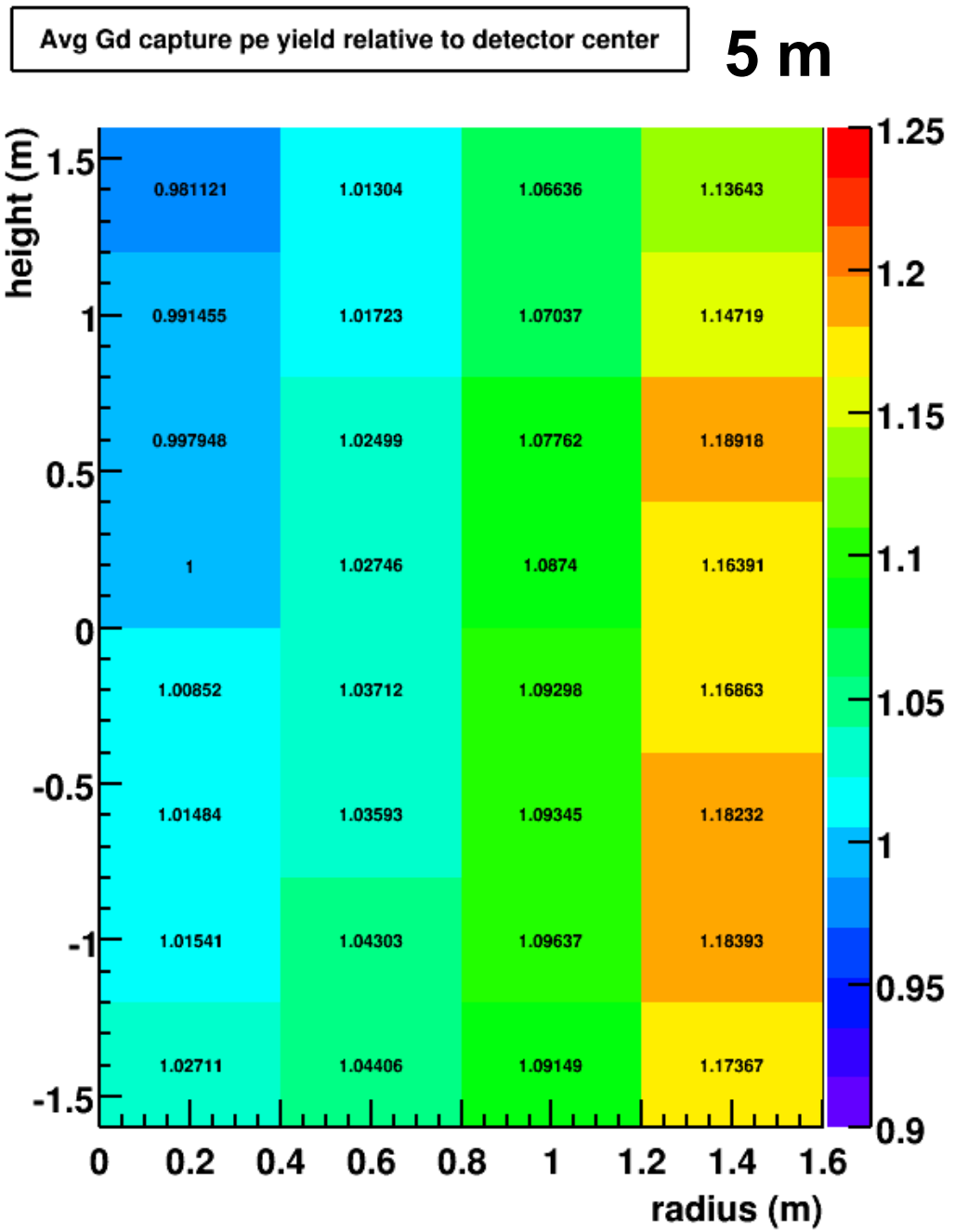
lower limit for attenuation length is ~3.5-4 m

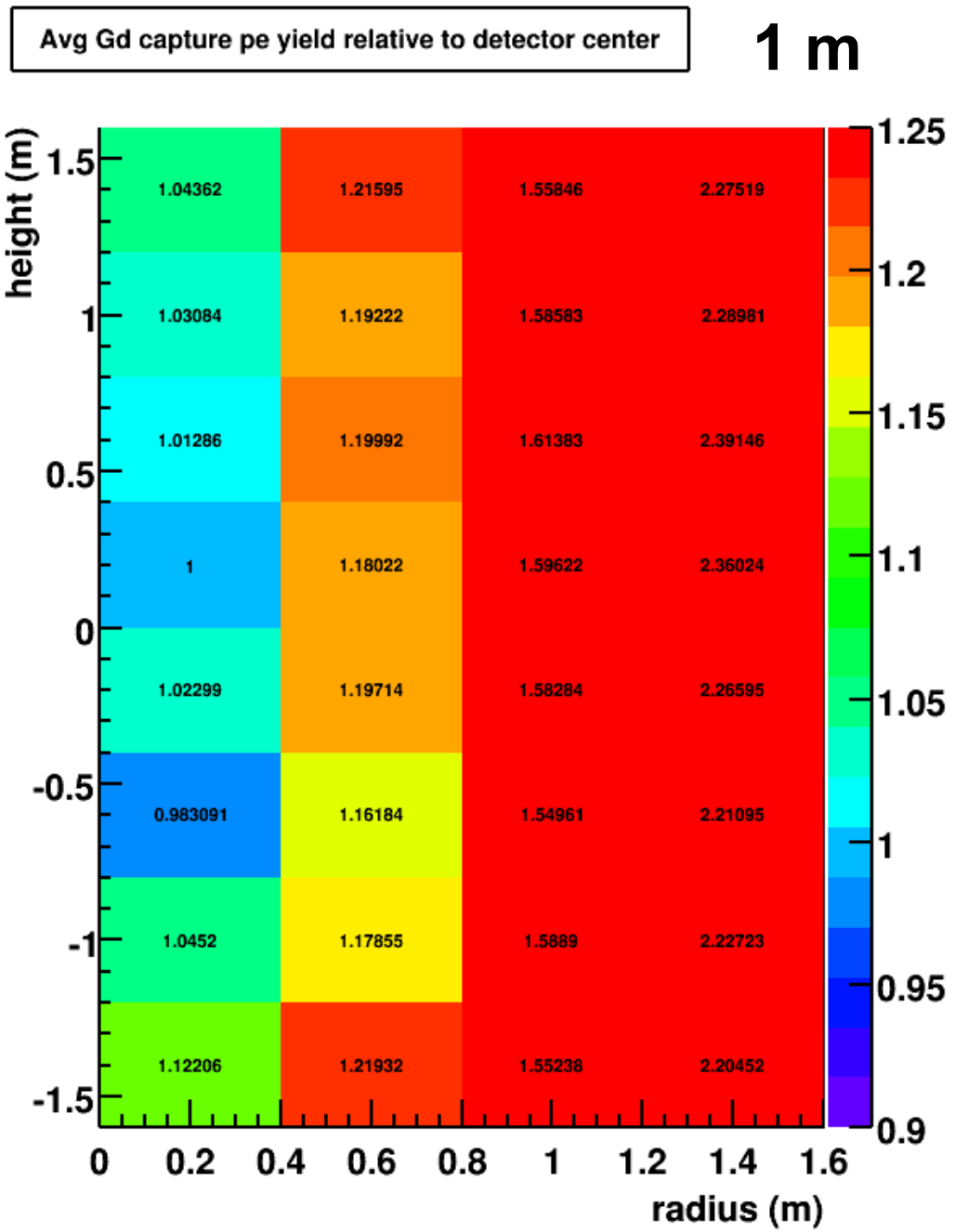
Gd capture pe yield uniformity





Gd capture pe yield uniformity





Conclusion

small changes in the spectrum at <400 nm and at the edge don't have a large effect on overall pe yield (but we need a good measurement to confirm the value)

assuming 9000 photons/MeV is correct...

attenuation length between 400-500 nm must be at least 4 m to meet the 100 pe/MeV requirement

BUT to meet a uniformity requirement of say 10% (what is the spec for this?) requires an attenuation length of at least 10 m